Notional Performance Specification

SMCM UUV

Disclaimers

- All material presented in this brief is in draft form. Any subsequent solicitation, if and when released, will be the authoritative document for all issues related to system performance.
- The government representatives participating in this Industry Day have no authority to direct you to expend funds to develop the capability described in this brief.
- This event does not obligate the Navy to any future acquisition or procurement action.

Performance Parameters

- Performance Requirements
- Operating, Staging, and Storage Environment
- Communications
- Interoperability
- Human Systems Integration (HSI)
- Reliability, Maintainability, and Availability
- Oceanographic Data
- Other

Within the constraints of performance requirements, a smaller vehicle is preferable to a larger vehicle.

Performance Requirements

Contact Localization Accuracy (CLA). The UUV system shall resolve a contact's geodetic coordinate position with a maximum error of 20 yards distance root mean squared (drms). (Objective: 10 yd drms.)

Probability of Detecting and Classifying Bottom Mines (P_dP_c). The UUV System shall have a 75% probability of detecting/classifying bottom mines and moored mine anchors/tethers in a single pass, while maintaining the required Area Search Rate. For purposes of this parameter, the bottom type shall be A-1, and the assumed target is cylindrical with a diameter of 53 cm and a length of 290 cm. (Objective: 90% with B-2 bottom type and cylindrical target of 45 cm and length of 192 cm.)

Probability of Detecting and Classifying Non Mines (P_dP_c). The UUV System shall have a 75% probability of detecting/classifying non mines in a single pass, while maintaining the required Area Search Rate. For purposes of this parameter, the bottom type shall be A-1. (Objective: 90% with B-2 bottom type)

Reference for bottom types: NWP 3-15.41

Performance Requirements
(con't)

Probability of Identifying a Mine as a Mine (P_{imm}). The UUV System shall have a <TBD> probability of correctly identifying mines that have been detected and classified as minelike. P_{imm} is calculated as the number of mines correctly identified as mines divided by the number of mines identified as mines plus the number of mines identified as non-mines. For purposes of this parameter, the bottom type shall be <TBD>. (Objective: 0.90)

Probability of Identifying Non-mines as Mines (P_{inm}). The UUV System shall have a <TBD> probability of incorrectly identifying as mines those non-mines that have been detected and classified as minelike. P_{inm} is calculated as the number of non-mines incorrectly identified as mines divided by the number of non-mines identified (both as mines and non-mines). (Objective: 0.10)

Area Search Rate (ASR). The UUV System shall have an ASR of 0.07 square nautical miles per hour. The ASR is the area searched by a single vehicle divided by the time to cover that area at the required search level against bottom mines on an A-1 bottom. The time span is from the time the vehicle enters the search area to the time the vehicle leaves the search area or has otherwise completed its search activity. False target density shall be no more than 14 per square

Performance Requirements
(con't)

UUV Endurance (V-Endure). The UUV endurance shall be a minimum of 10 hours. V-Endure is defined as the minimum time during the vehicle's duty cycle that it must be able to operate in the conduct of full sortie profiles. (Objective: 24 hrs.)
Buried Mine Detection and Classification (BMDC). The UUV System shall have at least a <TBD> percent probability of detecting and classifying mines and man-made objects that are 80 percent buried. (Objective: 80 percent probability of detecting and classifying mines and non mine mine-like bottom objects that are 100 percent buried to a depth of 6 inches.)

Operating, Staging & Storage Environment

Operating Current (Current). The UUV System shall be capable of operating in a current of 2 knots (from any direction), while meeting all performance thresholds. (Objective: 4 kts from any direction.)
Vehicle Terrain Following (Terrain). The UUV shall have the ability to operate over underwater terrains with an incline/decline angle of up to 10 degrees, while maintaining operational altitude and speed. (Objective: incline/decline angle of up to 45 degrees.)
Sea State (SS). The UUV System shall be capable of being launched, recovered, and operated in sea states from 0 to 3. Sea state 3 is defined as the significant wave height of 0.5 to 1 meter (1.6 to 4.1 ft). (Objective: Sea state 0 to 4, with significant wave height of 1.2 to 1.5 meters (4.1 to 8.2 ft.))
Minimum Operating Water Depth (MinWater). The UUV shall operate in a minimum water depth of 40 feet sea water (FSW) or less, while meeting all performance thresholds. (Objective: 10 FSW or less, while meeting all performance thresholds.)

Reference for sea state: Joint METOC Conceptual Data Model (JMCDM)

Operating, Staging & Storage Environment (con't)

Vehicle Maximum Operating Depth (MaxDepth). The UUV shall meet all performance requirements when operating at a depth of at least 300 FSW. (Objective: At least 1000 FSW.)
Vehicle Trim and Buoyancy Compensation (Trim). The UUV System shall meet all performance requirements while operating in water with salinity of 0-50 ppt. The UUV shall be capable of maintaining proper buoyancy and trim in water when the water salinity varies by ±10 parts per thousand (ppt) in a single sortie. (Objective: ±25 ppt salinity in a single sortie.)
Air Temperature. The UUV System shall be capable of operating in air temperature from 0°F to 109°F. (Objective: -20°F to 140°F)
Water Temperature. The UUV System shall be capable of operating in water temperatures from 32°F to 90°F. Operational Water temperature is defined as the water temperature while the UUV and the auxiliary equipment intended for use in/underwater are deployed for the UUV's required endurance. (Objective: 29°F to 110°F)

Operating, Staging & Storage Environment (con't)

Transportation and Storage Temperature. The UUV System shall perform satisfactorily after being transported and/or stored in a non-standby mode in temperatures from -4°F to 145°F . (Objective: -65°F to 160°F) [Ref: MIL-STD-810F, Method 502.4]

Transportation Altitude. The UUV System shall withstand the rigors (e.g., vibration, low temperature and pressure) of being transported by civilian or military aircraft (pressurized and non-pressurized) to altitudes of 15,000 ft. (Objective: 39,000 ft.) [Ref: MIL-STD-810F, Methods 500.4 & 514.5]

Temperature Shock. The UUV System shall be operable after encountering thermal shock associated with exposure to temperature extremes of 0°F to 109°F (air) and 32°F to 90°F (water). (Objective: -20°F to 140°F (air) and 29°F to 110°F (water).) [Ref: MIL-STD-810F, Method 503.4]

Transportation Shock and Vibration. The UUV System, when packed in its shipping containers, shall perform satisfactorily after being exposed to shock and vibration conditions which may be encountered during transportation over highways and secondary and tertiary roads, as well as by aircraft and sea vessels. [Ref: MIL-STD-

Operating, Staging & Storage Environment (con't)

Impact Survivability. The UUV System, while performing a mission shall survive a direct impact with an object and shall be able to complete its mission with minimal degradation at 3 kts. (Objective: 5 kts).

Electromagnetic Environments. The UUV System must withstand the adverse effects of electromagnetic environments (EMEs) that will be encountered during operations aboard surface ships. Therefore, the UUV System shall meet the Electromagnetic Interference requirements of MIL-STD-461E as follows:

Test Method RE101, Radiated Emissions, magnetic field, 30 Hz to 100 KHz

Test Method RE102, Radiated Emissions, electric field, 10 Hz to 18 GHz

Test Method RE101, Radiated Susceptibility, magnetic field, 30 Hz to 100 KHz

Test Method RE103, Radiated Susceptibility, electric field, 2 Hz to 40 KHz

Communications

Vehicle Communications (V-Comm). The UUV System shall be capable of periodically sending and receiving information between the vehicle and command and control station from over the horizon (OTH), at 2.4 Kbits/sec while the vehicle is at the surface. The information sent by the vehicle shall include, but not necessarily be limited to, vehicle health, vehicle position, and mission abort status. The vehicle shall also be capable of receiving and acting on mission execution orders from OTH on the surface. (Objective: vehicle transmit OTH at 500 Kbits/sec additional information including contact snippets, environmental data, and sensor performance factors.)

In-Mission Re-direct (Re-direct). The UUV shall be capable of being manually re-directed by an operator to perform a different or subsequent task/mission during a sortie, within the limits of the communications path. (Objective: Automated capability by the vehicle itself for re-acquisition sortie or maneuver to another operating area as determined by CAD/CAC.)

Communications (con't)

Lost UUV Recovery (Lost V). The UUV shall incorporate a independently powered locator within NATO standards to assist in locating a missing UUV and to facilitate recovery. (Objective: Independently powered locator that can be remotely interrogated.)

Information Assurance. All systems shall comply with the requirements of the Department of Defense Information Technology and Security Certification and Accreditation (DITSCAP) Program.

Interoperability

Vehicle Launch and Recovery Time (L&R). The UUV System shall be capable of launching and recovering a single vehicle from a surface platform within 30 minutes or less. Launch time begins when the vehicle is ready to be moved from the ship deck to the water's edge. Recovery time begins when the vehicle is ready to be connected to the recovery mechanism. This time excludes any pre-mission set-up and post-mission time. (Objective: 15 minutes or less.)

Shipboard Compatibility (Compat). The UUV System shall be suitable for deployment and recovery from an SMCM ship of opportunity without a major alteration. Considerations include, but are not limited to, shipboard footprint, weight and cube, mounting, storage, ancillary and support equipment requirements, electro-magnetic compatibility, handling requirements, and susceptibility to shock and vibration. The UUV System shall not adversely impact the shock and vibration certification of the MCM-1 Class ship or any other shipboard systems. (Objective: Deployable and recoverable from MCM-1 and LCS ship classes (fully integrated) and from shore, including a portable launch and recovery system to be utilized from various hull forms.) [Ref: MIL-STD-901D & MIL-STD-167-1]

Interoperability (con't)

Mine Warfare Environmental Decision Aids Library (MEDAL). The data processing and information subsystems of the UUV System shall be interoperable with the MEDAL Build 10 system for output reports and common display symbology. It must provide UUV post-sortie data into MEDAL (i.e. environmental, contact, and positional data). (Objective: Provide bi-directional interface to and from MEDAL Build 11 (i.e. sortie planning/tasks, environmental, contact data to include snippets, and positional data). Single console with MEDAL and UUV mission planning integrated.)
Joint Architecture for Unmanned Systems (JAUS). The UUV System shall conform fully to the JAUS standard developed by the Society of Automotive Engineers (SAE) and related DoD-adopted standards.
Power Compatibility. If the system uses batteries, all batteries shall be able to be charged using 110-220 VAC 50-60 Hz electrical power. The system shall be properly protected against overcharging and power surges.

Human Systems Integration (HSI)

Post-Mission Analysis Rate (PMA Rate). The time for a single operator to analyze data from a single vehicle sortie using a PMA tool shall not exceed one hour of PMA per sortie hour. This time includes data download time and incorporation into MEDAL. (Objective: 0.25 hr PMA per sortie hour.)
Turn-Around Time (TAT). The amount of time from the completion of a vehicle recovery to the start of launch for a subsequent sortie shall not exceed 60 minutes. This time includes upload of new program, and pre-mission maintenance. This time does not include battery charging, launch, recovery, and data download. (Objective: 30 minutes or less, including battery replacement and data download.)
Manpower (MP). The number of trained operators needed to safely maintain and operate the UUV System shall not exceed 5 personnel, exclusive of Launch and Recovery operations. (Objective: 5 personnel.)

Human Systems Integration (con't)

Cold Weather Clothing. The design of the UUV System shall provide for personnel wearing cold weather protective clothing to operate the required UUV System controls and switches for final pre-mission preparation and checkout, launch, and recovery of a UUV.
Nuclear, Biological, and Chemical Contamination (NBCC). The design of the UUV System shall provide for personnel wearing NBCC protective gear and clothing to operate the required UUV System controls and switches for final pre-mission preparation and checkout, launch, and recovery of a UUV.
User Friendliness (UF). The system shall be designed such that it can be easily operated and employed by an operator who has completed initial training provided for the system. UF is the ease with which operators, following initial training, can program a mission, deploy the system, and perform PMA.

Reliability, Maintainability & Availability

Reliability (R). The UUV System sortie reliability shall be at least 0.85 with a confidence factor of 80 percent. System sortie reliability is calculated as the number of successful sorties divided by the number of total sorties attempted by the system. A successful sortie is defined as sortie preparation, launch, operation, recovery, and download of mission data. (Objective: 0.95 with confidence factor of 80 percent.)

Maintainability (M). Maintainability is defined by the Mean Corrective Maintenance Time for Operational Failures (MCMTOF), which shall not exceed 5 hours for the UUV System. MCMTOF is calculated as the number of clock hours of corrective, on-system, active repair time that is used to restore failed system status after operational failures occur divided by the total number of operational failures. Corrective maintenance is the time during which one or more personnel are repairing a UUV System and includes preparation, fault location/isolation, correction, adjustment/calibration, and follow-up checkout time. This applies only to O-level repairable failures. (Objective: Not to exceed 2 hours.)

Reliability, Maintainability & Availability (con't)

Operational Availability (A). The UUV System shall exhibit an A of at least 0.90. A is defined as uptime divided by uptime plus downtime. (Objective: 0.95)
Battery Charging Time (Battery). If a battery or fuel cell is used to power the vehicle, it shall be rechargeable and must be able to meet DoD and DOT safety criteria to be shipped commercially via air, land, and sea. A full recharge from a 90 percent discharged state shall be accomplished in less than 12 hours. Batteries shall also maintain output performance for a minimum of 200 charge-discharge cycles. (Objective: Full recharge from a 90 percent discharged state in less than 6 hours. Battery output performance maintained for a minimum of 1000 charge-discharge cycles.)

Oceanographic Requirements

The UUV System shall record the following data at intervals not to exceed <TBD> in a format that is compatible with the Unified Sonar Imaging Processing System (UNISIPS).

UUV Depth (BP-SD). The system shall record the depth of the UUV with an accuracy of ± 2 percent of depth. (Objective: ± 1 percent of depth.)
Water Depth (BP-WD). The system shall record the depth of the water in which the UUV is operating, with an accuracy of ± 2 percent of depth. Water depth may be computed from system depth and sonar / doppler velocity log (DVL) returns. (Objective: ± 1 percent of depth.)
Sound Speed (BP-SS). The system shall record the sound speed within a range of 4500 to 5200 fps, with an accuracy of ± 1.5 fps. BP-SS may be computed using data collected by a conductivity, temperature & depth sensor. (Objective: Accuracy of ± 0.5 fps.)
Water Temperature (BP-T). The system shall record the water temperature in units of degrees centigrade, with a range of -4.0° to 45.0° C, and an accuracy of ±0.1° C. (Objective: ±0.05° C

Oceanographic Requirements (con't)

Salinity (BP-S). The system shall record water salinity in units of S/m, within a range of 0 to 9 siemens/meter, and an accuracy of ±0.0003 S/m. (Objective: accuracy of ±0.0001 S/m.)
Current (BP-C). The system shall record the water column current speed and direction, preferably using an upward and downward looking acoustic doppler current profiler. Current speed shall be, in units of knots, within a range of 0 to 10 kts, and an accuracy of ±0.2 kt. Current direction shall be in degrees from true north, with an accuracy of ±0.5 deg. (Objective: Accuracy of ±0.1 deg.)
Diffuse Beam Attenuation (BP-Kd). The system shall record BP-Kd at a wavelength of 532 nm, in units of m^{-1}, within a range of 0 to 30 m^{-1}, and an accuracy of ±0.02 m^{-1}. (Objective: Range 0 to 60.0 m^{-1} and accuracy ±0.01 m^{-1}.)
Bioluminescence (BP-Bio). The system shall record BP-Bio within a range of 1e5 to 1e10 photons/sec/ml, with an accuracy of ± <TBD> photons/sec/ml.
Water Clarity (BP-Cc). The system shall record BP-Cc at a wavelength of 532 nm, in units of m^{-1}, within a range of 0.04 to 12.0 m^{-1}

Oceanographic Requirements (con't)

Optical Backscatter (BP-OBS). The system shall record BP-OBS at a wavelength of 532 nm, in units of m^{-1}, within a range of 0 to 0.06 m^{-1}, and an accuracy of ±0.01 m^{-1}. (Objective: Accuracy of ±0.001 m^{-1}.)
GPS Figure of Merit (BP-FOM). The system shall record BP-FOM within a range of 1 to 9, with a resolution of 1.
Position Error (BP-PE). The system shall provide a method of determining horizontal position error, defined by along-track error, cross-track error, and heading/azimuth error at any given time in the sortie. The determination of error may occur during post-mission analysis.

Other

Vehicle Abort/Recall (V-Recall). The UUV shall have the capability to abort a mission in the event of a system malfunction or operator action and return to a defined position.

Global Positioning System (GPS). If GPS is used for navigation of the UUV during ingress, egress, or the mission sortie, it shall use military P-code capable receivers with Selective Availability Anti-Spoofing Module (SSASM).

Data Storage Capacity. The on-board UUV data storage capacity shall be capable of storing all data collected during a single sortie of maximum endurance.

Low Visible UUV. The UUV shall maintain a low profile above the water while transmitting.

System Shipment (Shipment). The UUV System should be designed such that it can be shipped commercially or inside one or more Transportation Equivalent Units (TEUs) via military or commercial ground, air, and sea assets

- System w/ ≤ 12.75 inch dia. vehicles: commercially shippable 3 days (FEDEX or equiv.)
- System w/ > 12 inch diameter vehicles, maximum size TEU (8x8x20 ft container)